Application Note

Loop Analysis using DSL Data HLog, QLN, SNR, and BPT

By John Williams

HLog Data

HLog data reported during the modem initialization phase shows attenuation over frequency. A clean line HLog plot should look similar to the graph in Figure 1 where the slope of the attenuation curve declines slowly and evenly from left to right or from lower frequencies to higher frequencies. Colors indicate active bands in the profile, blue for downstream and red for upstream.

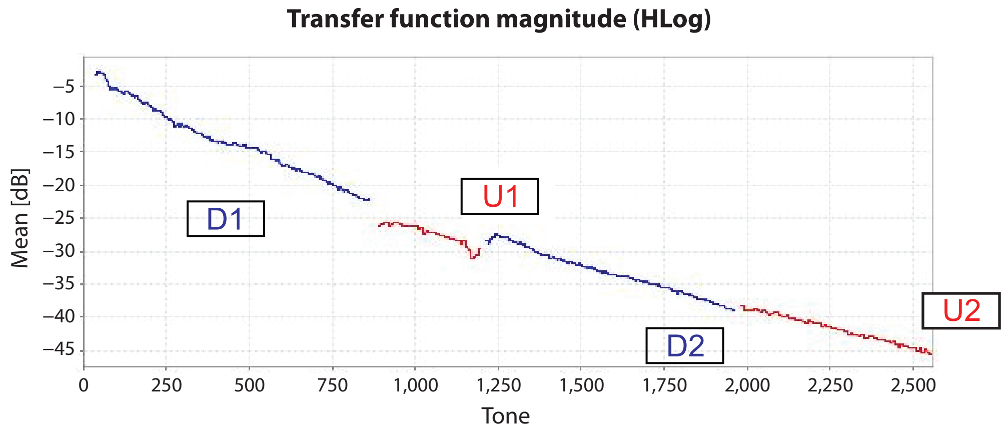

Figure 1. Optimal clean line HLog plot

Bridged Tap Impact

HLog data can indicate the presence of certain impairments. The HLog graph in Figure 2 shows a dip at Tone #1325 for the first null (approx. 5.7 MHz [1325 x 4.3125 kHz]) of an impairment caused by a bridged tap. The dip Figure 2 that looks like a valley with sloping sides is the tap signature. The tap length can be estimated with this formula: 160 ÷ Frequency in MHz = Tap Length in feet using the frequency in MHz at the point of the first null, or center frequency of the dip.

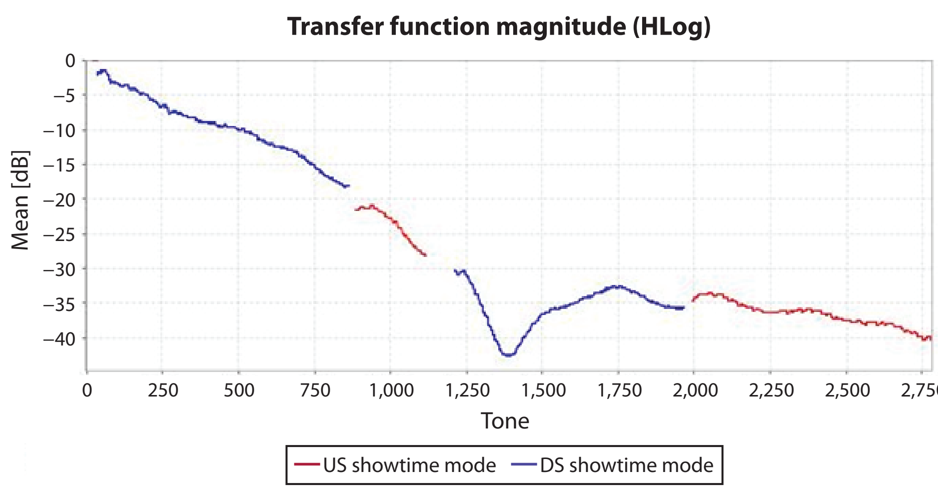

Figure 2. HLog graph indicating impairments

Different cable types and gauges change in the velocity of propagation and will affect the constant, however, adjustments can be made. For example, KPN (the state carrier of the Netherlands) uses 60 (length in meters) for GPLK and 50 (meters) for GPEW cable. In North America, a 26-gauge cable might use a constant of 162 to determine tap length in feet based only upon a gauge change. However, many variables apply, such as the cable make-up, cable conditions, and more. Thus, using the one factor of 160 produces good results and reduces complexity for North American copper plants.

Other impairments types can be seen in HLog data. This HLog data plot in Figure 3 shows a large roll-off or increased attenuation in the lower frequencies that is characteristic of a capacitive issue typically associated with poor electrical connections with one of the loop leads in a connector at the premises.

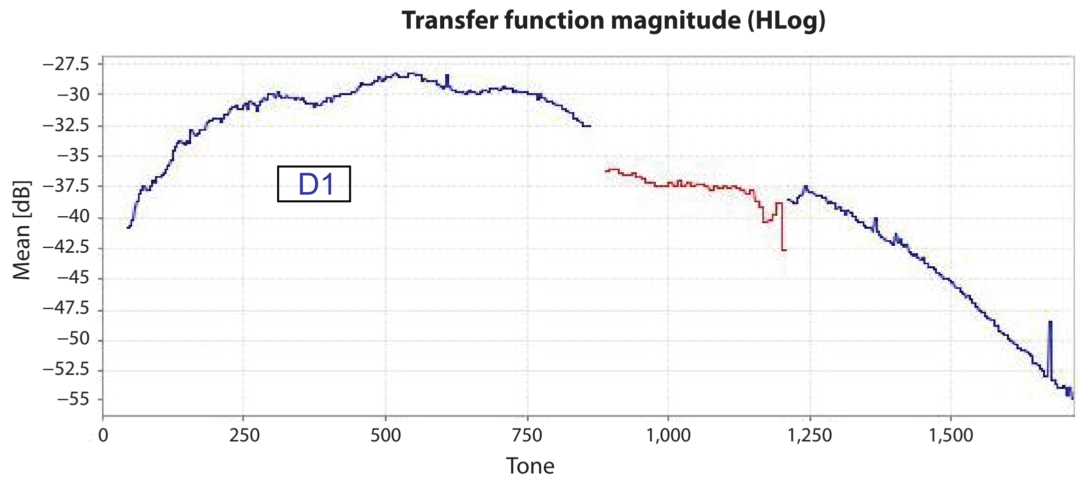

Figure 3. Other types of impairments

QLN Data

Modems gather quiet line noise (QLN) data when no Digital Subscriber Line (DSL) signal is active on the line during initialization. QLN indicates the noise levels in dBm/Hz over frequency (in Figure 4, frequencies as in tones) across the applicable DSL spectrum in use. In Figure 4, the green line indicates one test snapshot and the blue line indicates another test snapshot slightly later in time. It also shows noise spikes, such as the one spike at tone 175, and indications of high crosstalk; in Figure 4, the energy around the wider spike at tone 50.

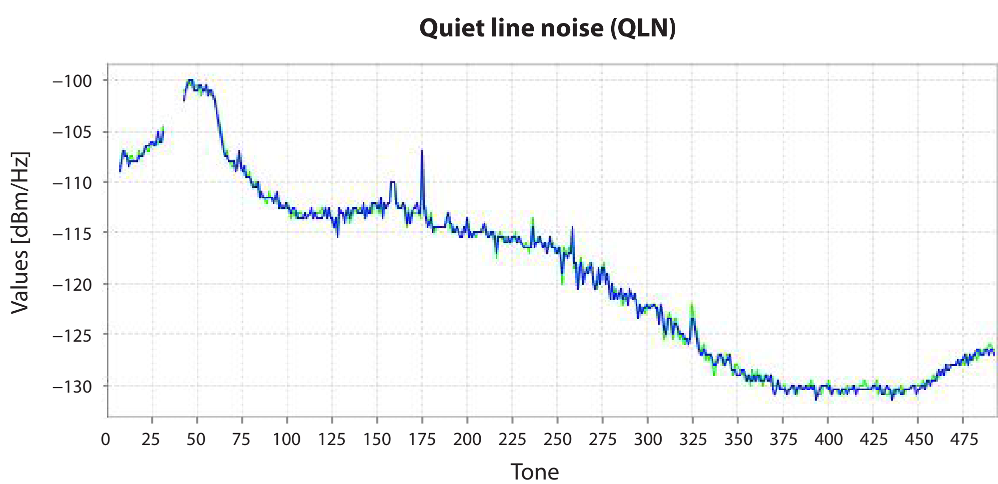

Figure 4. Two QLN test plots

Signal-to-Noise Ratio Data

Signal-to-noise ratio (SNR) data, as shown in Figure 5, indicates how the modems have analyzed the line and determined the SNR per tone. This data may change over time as line conditions change due to temperature variations or moisture in a cable.

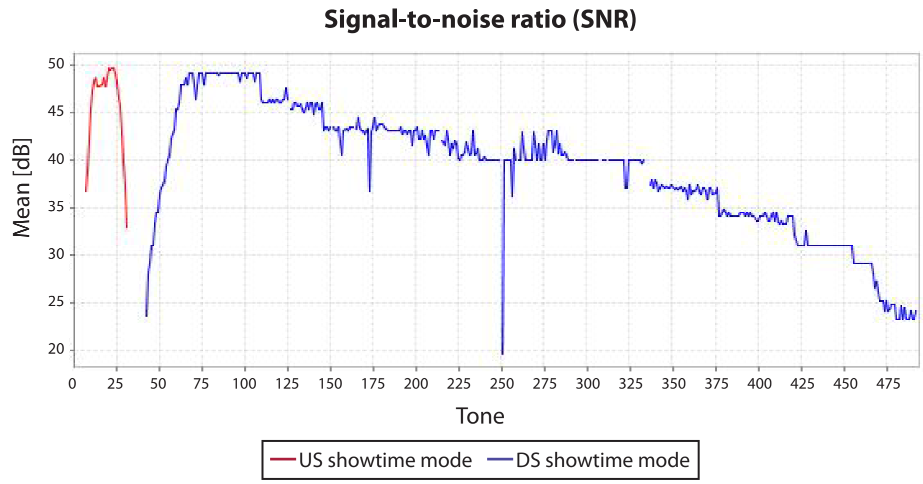

Figure 5. SNR data per tone as analyzed by the modems

Bits per Tone Data

The bits per tone (BPT) in Figure 6 show the modem analysis of the line regarding signal strength, attenuation, and noise with the resulting bit loading for each tone. Several areas in this example indicate that no bits were assigned, such as tones 125 and 150, due to noise.

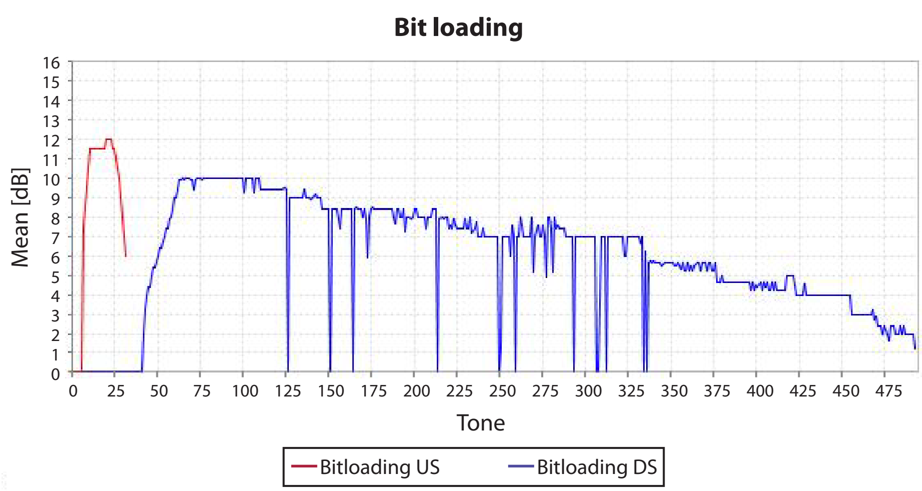

Figure 6. Bits per Tone showing modem analysis of the signal strength, attenuation, and noise

Correlating Data

HLog data can indicate physical copper loop conditions, such as the presence of taps or a capacitive problem. QLN data can show noise events, including crosstalk and radio frequency interference (RFI). SNR data can show time-dependant changes in crosstalk levels and loop attenuation due to temperature changes or moisture issues.

Correlating the BPT data with QLN will easily show how noise spikes impact bit loading. Correlating BPT with HLog data will also show how impairments, such as bridged taps and poor contacts, in a premises impact bit loading.

Analyzing HLog, QLN, and SNR helps users to determine why data rates fail to reach the maximum possible rates.

The addition of HLog and QLN data to the JDSU modem test suites has enhanced loop analysis which will help to rapidly identify faults and reduce time to repair. Figures 7a and 7b show the easy to read analysis results that the JDSU modem test suite provides.

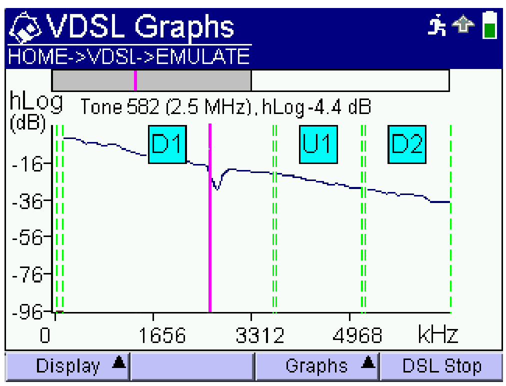

Figure 7a. Dual pair HLog Graph showing likely bridged tap on pair 1 at tone 582

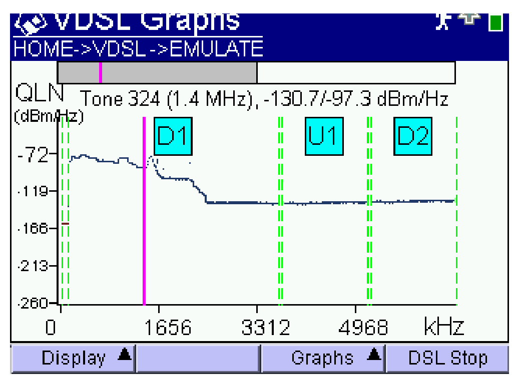

Figure 7b. Dual pair QLN graph showing noise on pair 1.

 30168451 000 0711 LOOPANALYSIS.AN.TFS.TM.AE July 2011